# STUDY OF VARIOUS CONTROLLERS FOR ROBOTIC HAND

Prof.Vikram M.Kakade[1], Mr. Tushar S. Rajapure[2] , Ms. Roshni K. Chavan[3]
[1] Assistant Professor & Guide, Department of Elect & Telecomm Engg., PRMCEAM-Badnera
[2,3]UG Student, Department of Elect & Telecomm Engg., PRMCEAM-Badnera

**Abstract**

**The main objective of this research paper is to study the various controller for designing robotic hand. The robotic hand controlled by various controllers like Arduino, raspberry pi, AVR and PIC. Through this we can perform various task. This will reduce the human efforts and growth of robotic industries.**

**Index Terms: Arduino, AVR, Degree of freedom, PIC, Raspberry Pi Robotic arm.**

## I. INTRODUCTION

The application of robotics field is broadly used in the field of research, laboratory based work, industrial work to automate process and reduce the human errors. This paper is describing the design of mechanical structure of a robotic arm. This robotic arm is often indicated to move an object from one place to another place. In the field of robotics, the beginner can contribute many functional operations in the world. This arm can solve many human's limitations. Many people cannot move from one place to another place for their limitation but they have needed to move for collect something like mug, jog, and so on. For that they require getting help from other persons. When they use this type of robot they can solve their problem easily without help other person for its easy operation system. There are various ways in which a robotic arm may be controlled. In the past there have been many researchers working to control robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be controlled from anywhere in the world. Usually most of the robotic arms are controlled by a central controller which makes uses of values taken in from the terminal that are entered by the user at the terminal to move the arm to particular coordinates in space. This makes the control very difficult as the control values of the motors are very difficult to predict to achieve a particular movement. Here are some controllers that we are going to study as follows

## II. OVERVIEW

The term robot comes from the Czech word robota, generally translated as "forced labor." This describes the majority of robots fairly well. Most robots in the world are designed for heavy, repetitive manufacturing work. They handle tasks that are difficult, dangerous or boring to human beings. The most common manufacturing robot is the robotic arm. A typical robotic arm is made up of seven metal segments, joined by six joints. The computer controls the robot by rotating individual step motors connected to each joint (some larger arms use hydraulics or pneumatics). Unlike ordinary motors, step motors move in exact increments. This allows the computer to move the arm very precisely, repeating exactly the same movement over and over again. The robot uses motion sensors to make sure it moves just the right amount.

## III. DEGREE OF FREEDOM

A degree of freedom is a joint on the arm, a place where it can bend or rotate or translate. We can typically identify the number of degrees of freedom by the number of actuators on the robot arm (in case of serial arms). The gripper is often complex with multiple DOF or can be a toll for welding etc., so for simplicity it is treated as separate subsystem in basic robot arm design. The term is important in mechanical systems, especially biomechanical systems for analyzing and measuring properties of these types of systems that need to account for all six degrees of freedom. Measurement of the six degrees of freedom is accomplished today through both AC and DC magnetic or electromagnetic fields in sensors that transmit positional and angular data to a processing unit. The data is made relevant through software that integrate the data based on the needs and programming of the users. Ascension Technology Corporation has recently created a 6DoF device small enough to fit in a biopsy needle, allowing physicians to better research at minute levels. The new sensor passively senses pulsed DC magnetic fields generated by either a cubic transmitter or a flat transmitter and is available for integration and manufacturability by medical OEMs. An example of six degree of freedom movement is the motion of a ship at sea. It is described as

A. *Translational envelopes:*

1.Moving forward and backward on the X-axis. (Surge)

2.Moving left and right on the Y-axis. (Sway)

3.Moving up and down on the Z-axis. (Heave)

B. *Rotational envelopes*

1. Tilting side to side on the X-axis. (Roll)
2. Tilting forward and backward on the Y-axis. (Pitch)
3. Turning left and right on the Z-axis. (Yaw)

there are three types of operational envelope in the Six degrees of freedom. They are Direct, Semi-direct (conditional) and Non-direct, all regardless of the time remaining for the execution of the maneuver, the energy remaining to execute the maneuver and finally, if the motion is commanded via a biological entity (e.g. human), a robotically entity.

1- Direct type: Involved a degree can be commanded directly without particularly conditions and described as a normal operation. (An aileron on a basic airplane)

2- Semi-direct type: Involved a degree can be commanded when some specific conditions are met. (Reverse thrust on an aircraft)

3- Non-direct type: Involved a degree when is achieved via the interaction with its environment and cannot be commanded. (Pitching motion of a vessel at sea) Transitional type also exists in some vehicles. For example, when the Space Shuttle operates in space, the craft is described as fully-direct-six because its six degrees can be commanded. However, when the Space Shuttle is in the earth's atmosphere for its return, the fully-direct-six degrees are no longer applicable for many technical reason

## IV. TYPES OF CONTROLLERS

### A. *Arm Controller*

AVR was developed in the year 1996 by Atmel Corporation. The architecture of AVR was developed by Alf-EgilBogen and VegardWollan. AVR derives its name from its developers and stands for Alf-EgilBogen VegardWollan RISC microcontroller, also known as Advanced Virtual RISC. The AT90S8515 was the first microcontroller which was based on AVR architecture however the first microcontroller to hit the commercial market was AT90S1200 in the year 1997.An 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively.

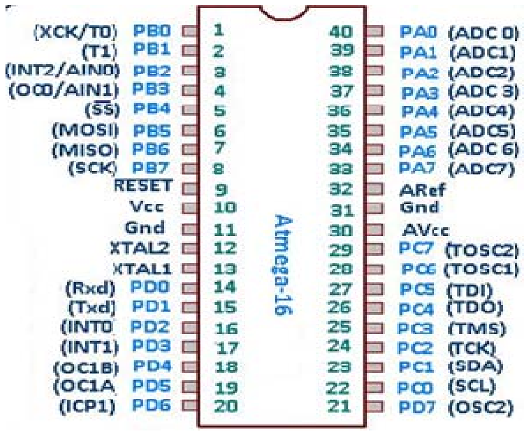


Fig.4.1 pin diagram of atmega 16

*B. Arduino*

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

The key features are:

• Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off connect to the cloud and many other actions.

• You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).

• Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.

• Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.

• Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.


Fig.4.2 Arduino Uno microcontroller board (interface)

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

*C. Raspberry Pi*

The Raspberry Pi is available in two models- Model A and Model B. The Model A is cheaper compared to Model B but lack some connectors. It was initially started with the intention of teaching the basic computer science in schools but later turned out to be a wonder in the field of single board computers. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor (The user can attempt overclocking, up to 1 GHz, without affecting the warranty), Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Broadcom BCM2835 incorporates an ARM1176 processor core. The ARM processors are low-cost yet high performance processors used in smart phones, digital TVs, eReaders and other media devices. ARM licenses the processor to other companies, like Broadcom, who combine it with various I/O modules and incorporate it into systemon- chip designs. ARM, also provides the physical IP for the digital inputs and outputs (GPIO) as cell libraries

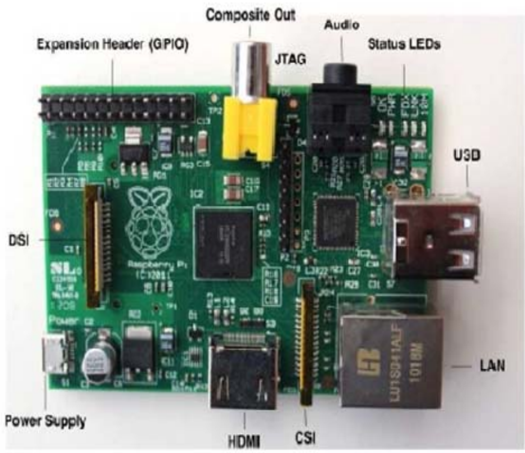


Fig.4.3 Raspberry Pi

*D. PIC microcontroller*

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

Early models of PIC had read-only memory (ROM) or field- programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions.

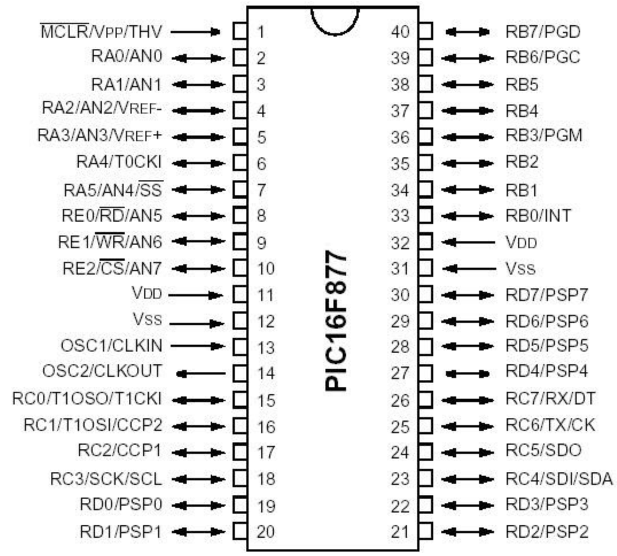


Fig.4.4 PIC microcontroller pin diagram

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The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.

The manufacturer supplies computer software for development known as MPLAB X, assemblers and C/C++ compilers, and programmer/debugger hardware under the MPLAB and PICKit series. Third party and some open-source tools are also available. Some parts have in-circuit programming capability; low-cost development programmers are available as well as high-production programmers.

PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, serial programming, and re-programmable Flash-memory capability.

## V. Conclusion

Our design uses extremely simple ideas and mechanisms to achieve a complex set of actions is intended imitate the action of the operators. However, these hydraulic arms are expensive for small scale industries. If the major problem of high initial coast is addressed, a robotic hydraulic arm can be introducing in any industry to bring in automation the mechanical links and parts that have been fabricated are extremely simple. The prepared mechanism has been successfully constrained and execute to carry out the required work of picking up the weight of the object and put them into the placed at different location.

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